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SPINACH GROWING AND PREPARATION FOR MARKET

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A. G. B. Bouquet
Horticulturist (Vegetable Crops)

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Spinach is the most important vegetable grown for "greens," being of particular value in the northern states during the spring, early summer, fall and early winter. Spinach is widely grown all over the country at different times of the year, and is always available from one section or another of the United States.

The increase in popularity of this vegetable was outstanding from the period of 1918 to 1928. In 1918 it was estimated that there were 10,000 acres of spinach with a total value of \$2,000,000. The acreage for the 10-year period of 1928 to 1937 was estimated at 57,250 for the United States. In 1939 the acreage was estimated at 61,030. Of this amount Texas led with 35,400 acres, with other producing states including New Jersey, Pennsylvania, Virginia, Louisiana, Missouri and California. All of the above figures refer to the growing of spinach for shipment or local marketing.

Statistics concerning the growing of spinach for manufacture, particularly for canning, indicate quite a marked reduction in acreage since the 10-year period of 1928 to 1937, during which time the acreage was estimated at almost 25,000 acres. In 1939 17,860 acres were reported as having been planted to spinach for manufacture. California, which has the greatest acreage of spinach for canning, had a 10-year average from 1928 to 1937 of 11,110 acres, but the acreage in 1939 was only 7,860.

The high point in canning spinach was reached in the year 1929 when 96,900 tons of spinach were packed. In 1939 the estimated total was 47,200 tons. These records are for canning spinach and evidently do not include the tonnage now produced for freezing preservation.

Spinach is one item which has continued a marked upward trend in production for freezing preservation. In the Pacific Northwest the increase was from 792,659 pounds in 1937 to 2,104,239 pounds in 1939. California also produced a record frozen pack in 1939 of 514,000 pounds. Other packs were reported from Michigan, Maryland, Texas and New Jersey.

The increased consumption of spinach has been due largely to a better understanding of the value of the vegetable in the diet. Spinach is rich in minerals and vitamins A, B, C and D. It has often been called "the broom of the stomach." It can now be transported long distances under ice and, as indicated, is becoming increasingly popular as a frozen food.

Plant characters. Spinach is an annual vegetable of rapid growth. The leaves form a rosette from the center of the plant, from which the flower stem and seed stalk make their appearance more or less speedily according to the variety, the length of day and temperature prevailing. The wild form of spinach had arrow-shaped, pointed leaves but most of the cultivated varieties today have broad and round leaves, some varieties being remarkable for the thickness of the leaves. The leaves may be comparatively smooth, as in the thick-leaved varieties, or blistered, savoyed or crumpled, as is typical of the savoyed varieties.

The petiole or stem material is rather important, particularly in the canned product. The greater the proportion of stem material, the less attractive is the resulting canned product, and also the more waste when trimming the raw stock preparatory to manufacture. It has been found that the ratio of petiole material may range from 16 to 37 per cent, depending upon the varieties in question. The smooth-leaved varieties seem to produce more petiole or stem material than the savoyed-leaf types. The distances at which the plants are growing in the row may also affect the length of stem.

There are two generally accepted stages of growth in spinach: first, the crown development, and second, the flower stalk formation. The crown development is shown in the rosette of leaves which are borne about the short but compact stem of the plant as a whole. The proper time for harvesting the edible leaves of the spinach plant is when the plant is still in the crown or rosette stage. The maximum yield may usually be obtained just before the plants start to form the flower stalk. The flower stalk formation may be affected by two factors: first, weather conditions and temperatures prevailing, and second, hereditary factors. Spinach is naturally a cool weather plant. It does not thrive well in hot weather, but has a tendency to "bolt" or make a seed stalk. Another environmental factor is the length of day, which seems to be almost as important in the development of the seed stalk as temperatures. Spinach plants growing under the short day length of the winter months are apt to develop seed stalks more quickly if they have been growing for a month or so in temperatures of from 40 to 50 degrees and this is followed by warmer temperatures up to 70 to 80 degrees. Again, when spinach plants are growing under a long day of 14 to 15 hours, they will develop seed stalks quite quickly if the temperatures are relatively high. Thus it is common to find spinach going to seed during the longer, warmer days of the spring and summer but remaining in a vegetative or leafy growth during the short days in the winter.

The spacing of plants may also be a factor in inducing flower stalk formation. When crowded, the plant stems elongate and do not form a good rosette. They likewise show an increase in proportion of undesirable stem material and are more liable to develop seed stalks.

The plant is one which will stand considerable frost and in many places, therefore, it is planted in the fall to winter over for spring harvesting.

There are four types of plants in the sex of spinach: (1) extreme males, (2) vegetative males, (3) male and female, (4) females. In general spinach culture the ratio of male and female plants is about one to one. The male plant dies after flowering while the female plant continues to develop and ripen its seed.

As previously indicated, there are two distinct types of leaves, the flat-leaved type and the savoy-leaved type. Of the flat-leaved varieties there are three groups, the short season group, the long-standing group, and the slow-growing group.

Of the short season group the Viroflay and Giant Eskimo are examples. In the long-standing group are such varieties as Thick Leaf, Giant Nobel, Amsterdam Giant Long Standing, and Hollandia, the last two being prickly seeded as opposed to many varieties which have smooth seeds. In the slow growing group the variety King of Denmark is outstanding in regard to its adaptation for late spring harvesting.

Of the savoy-leaved varieties there are also three groups, the short season, long standing, and slow growing. In the short season group is the variety Bloomsdale and Virginia Savoy. In the long standing group are selections from the original Bloomsdale, while in the slow growing group are such varieties as Victoria and Princess Juliana.

The smooth-leaved varieties are more suitable for canning purposes than the savoy types and for the most part they are slower in producing seed stalks. A long standing variety of the smooth-leaved type grows slowly and stands for a longer time without developing a seed stalk.

Soils and Fertilizers. Spinach can be satisfactorily produced on a variety of soils, but the largest yields are obtained from those soils which have an abundance of humus in them, so that the plant can derive an ample supply of nitrogen and also have plenty of moisture to make a heavy yield. Sandy and silt loam soils are especially desirable for spring planting, so that seedings can be made as early in the spring as possible in order to mature the crop before hot weather. For planting in the fall for a wintered-over crop, well drained soils must be used. For later spring production sub-irrigated soils of an organic nature are best in that they retain moisture to provide a heavy yield. Soil for spinach must be pulverized to a fine degree so that proper seeding may be made on smooth ground.

It is also necessary to consider the degree of acidity or alkalinity of the soil. Spinach is not tolerant to a soil of high acidity, and also does not do well on land that is definitely alkaline. In cases of the latter, chlorosis or yellowing of the leaves may take place. From various trials of spinach growing on land differing in degree of acidity, it is evident that the reaction range for best growth occurs between pH 6 and pH 6.5, or in other words, a slightly acid soil. Heavy applications of lime may be both dangerous and wasteful, but acid soils must be limed for producing good yields.

Due to the scarcity of manure, it may be necessary to use soil improvement crops, together with commercial fertilizer for a good yield of spinach. On a small scale stable manure may be available for application, but on larger areas other methods of fertilization must be used.

The removal of plant food by a crop of spinach indicates that by far the largest element used by the plant is nitrogen. It has been estimated that in an average yield, there are removed approximately 68 to 70 pounds of nitrogen per acre, 23 pounds of phosphorus and 40 pounds of potash. Nitrate of soda and calcium nitrate (16% N.) are valuable nitrogen fertilizers in that they are readily available and do not acidify the soil. Cyanamid (21% N.) may also be used to advantage in that it is an alkaline nitrogen fertilizer. Results in fertilizing spinach indicate that the greater part of the fertilizer should be applied before planting, at least one-half to two-thirds of the amount, the remainder being used for side or row placement. If 200 pounds of fertilizer are used per acre as a side dressing, and the rows are 15 inches apart, one-half pound of the fertilizer would be used

per 100 linear feet. If 1000 pounds of a complete fertilizer were used per acre, this amount would be broadcasted before planting but it is quite possible that equally good results would be obtained by using 200 pounds or so in row placement and this would be cheaper.

Calcium nitrate is useful in soils known to be acid, but the calcium or lime in this material tends to make a more woody growth and less succulent stems and leaves. In soils that are not acid it may be advisable to use nitrate of soda instead of calcium nitrate. It has been generally observed that phosphoric acid fertilizers have a tendency to increase the rapidity with which the plant produces a seed stalk. It is also believed that phosphorus in abundance tends to offset the value of nitrogen in making a leafy, succulent growth. Spinach apparently removes comparatively little phosphorus in a normal yield, and this fertilizer might be entirely eliminated in a mixed fertilizer or at least considerably reduced in its ratio to nitrogen and potash. However, in some fertilizer tests, superphosphate has been an active agent in increasing the yield. When used with a nitrogen fertilizer, it may be helpful in increasing the yields over that produced by the nitrogen fertilizer alone. Arizona reports 65 per cent increase over unfertilized plots when superphosphate was used in conjunction with nitrate of soda.

It is probable that a sufficient amount of a potash-carrying fertilizer should be included - one hundred pounds or so per acre in order to provide for a readily available supply of potash, although there is little evidence at hand experimentally to indicate the particular value of this element.

The use of some minor elements such as boron and manganese has been attended with favorable results in some parts of the United States in growing spinach. Manganese has been particularly useful where soils have a tendency to be moderately alkaline. In field trials at the Oregon Experiment Station at Corvallis, the application of 30 pounds or so of commercial borax per acre has increased the yield of spinach 60 per cent.

Seed and Seeding. It is evident that there are differences in the value of strains of the same varieties and, therefore, the best seed obtainable should be used in growing any quantity of spinach for market, for canning, or for freezing. The amount of seed used per acre varies according to the thickness of seeding and the distance between rows. It has already been pointed out that too thick a stand of plants may result in small, spindly plants and also the possibility of an early bolting to seed. Usually from 8 to 12 pounds of seed are used per acre. If the rows are 15 inches apart an average of 10 pounds per acre will be used. Closer planting necessarily requires slightly more seed.

The seed is usually sown in the cool seasons of the year, either in the fall or during varying parts of the spring, beginning from the earliest opportune time until mid-April. In the late summer or early fall, plantings can be made as early as August 20 to September 1 for fall harvest and there on up to October 15 for wintering over the plants.

Spinach is a crop which normally completes its growth up to harvest time in from 42 to 60 days, depending on the season and its temperature.

The plants are quite subject to damping-off and experimental trials have shown the wisdom of using such seed protective materials as red copper oxide and

Semesan, particularly where plantings are being made in cool and moist soil. Approximately four ounces of red copper oxide would be used in treating 10 pounds of seed. The treatment is inexpensive and efficient.

Cultivation. Inasmuch as the rows of spinach are quite close together, cultivation is largely done by hand except where the crop is grown on a scale extensive enough to warrant the use of power-propelled tools. Cultivation is done largely to control weeds, particularly the early small weeds between the rows. It is especially important to keep the rows clean in the early growth of the crop. A good deal of weed growth can be controlled by growing the crop on clean land and possibly destroying the first lot of weeds before seeding.

Irrigation. If supplementary irrigation water is available, it is useful in helping to obtain a uniform stand of plants as well as providing moisture through a period of drouth so that at no time do the plants suffer from lack of soil moisture. With the rows as close together as spinach is planted, some form of sprinkling distributes the water in a desirable form for this crop. Sometimes in spells of warm, humid weather, such sprinkling may increase the possibility of the prevalence of downy mildew.

Harvesting. In order to obtain as large yields as possible, it is advisable to allow the spinach to grow to the point of beginning to show signs of making seed stalks. As previously mentioned, the largest yields are obtained just before this development takes place. There will be a particularly rapid development of the plants during warm weather and the crop must be watched very carefully during such a period.

In harvesting, the taproot is cut just below the surface of the soil with a sharp instrument, such as a sharp shove hoe or two-wheeled hand hoe with the knives reversed. A sufficient amount of the root must be cut to hold the leaves intact. Because of the tenderness of the leaves and the readiness with which they become dirty, spinach should not be cut when wet with dew or rain. Proper harvesting of the spinach can be done in such a manner so that the plants fall over systematically to one side of the row and are easily picked up.

Grading and packing. Specifications for federal grades for either market spinach or spinach for manufacture can be obtained from the United States Department of Agriculture at Washington, D. C., or from the State Department of Agriculture, Salem, Oregon.

Spinach should be clean, bright, and have an attractive appearance. Distinct varietal types, such as the smooth and savoyed varieties, should not be mixed. The plants should be of good size, well trimmed and fresh in appearance. They should also be free from decay, yellow or discolored leaves, seed stems, insects and dirt.

There are possibly three types of containers used on the Pacific coast in marketing fresh spinach, orange boxes holding 20 pounds, Walla Walla crates of 18 pounds, California standard lettuce crates of approximately 40 pounds. Most of the California spinach is package-iced.

The season for local spinach will depend very largely upon the mildness of the winter and the readiness with which the plants may grow in the early spring. The first crop cut is that grown from fall planting. The peak of harvesting usually occurs sometime during late April and early May. There is a marked decrease of

spinach when warm weather begins. The fall crop is harvested from early September on to the time when severe weather puts an end to cuttings of satisfactory spinach.

Yields and Values. The average yield per acre of spinach for the United States as a whole in 1939 was 220 bushels. The ten year average from 1928 to 1937 was 218 bushels. In the growing of spinach for manufacture, the ten year average from 1928 to 1937 was 3.68 tons for the main producing states, California reporting four tons per acre. It is evident from the yields of different years that the tonnage may run from $2\frac{1}{2}$ to 5 tons per acre. In some fields of high fertility, the tonnage may run twice that amount. As a matter of fact, yields of spinach in California are estimated at 10 tons, high; 4 to 5, average; and 3 tons and less, medium to poor.

Locally grown spinach may range in value from \$1.25 per 20-pound box to 50 cents or so. Contract prices for spinach vary from \$15 to \$20 per ton.

Insects and Diseases. The western twelve-spotted cucumber beetle is sometimes quite injurious to spinach, eating parts of the leaves in the spring when the beetles first emerge from hibernation and find but little green feed on which to prey. Pyrethrum dusts or sprays may be effective in control.

Spinach aphids sometimes cause serious injury. If present the plants must be dusted with a standard nicotine sulfate dust or spray.

The leaf miner sometimes makes a sudden appearance, and may quickly do much damage. There is not much evidence that the miner may be present and consequently control measures are oftentimes delayed until the damage has already been done. Repeated applications of nicotine sulfate spray or dust are suggested.

Diseases of spinach which are liable to occur include downy mildew, rust, mosaic and curly top. Downy mildew is sometimes prevalent during warm, humid weather. The under surfaces of the leaves show patches of dense gray material. This is a difficult disease to control due to the low-growing habit of the leaves and the difficulty of applying any dust or spray to the undersides of the leaves.

Rust on spinach was reported in 1922 as having caused severe injury, but normally it is not a significant disease.

Spinach is susceptible to curly top caused by leaf hoppers, but due to the time of the year when the crop grows, it is improbable that this disease will materially injure the plants. Most spinach is harvested before the plants might be affected by the hoppers.

Mosaic may be present in some fields, being detected by the mottling of the inner leaves which turn yellow and die. Later the outer leaves turn yellow and are curled and wrinkled. Most mosaic-affected plants are dwarfed in growth. Aphids spread the disease in the field. The more resistant varieties of spinach are not adapted for market or canning.